NASA EARTH SCIENCE ENTERPRISE TECHNOLOGY PLANNING WORKSHOP

Workshop Overview

January 23-24, 2001
Hyatt Arlington Hotel
Arlington, VA

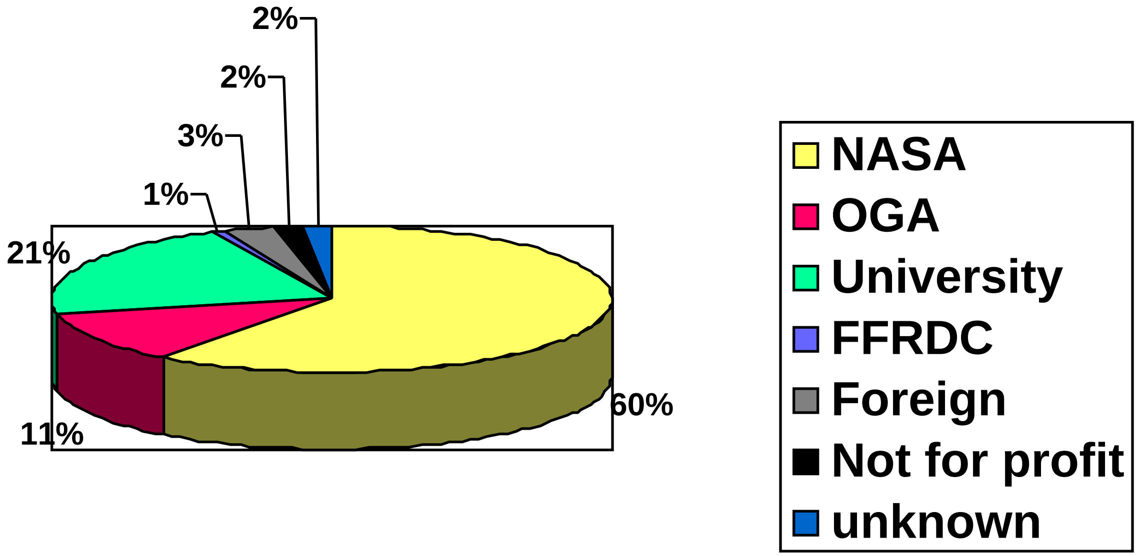
Background

- NMP and ESTO have initiated planning for spacecraft and instrument technologies to enable Earth Science Enterprise (ESE) missions with a time horizon of 5 to 15 years
- Derived from existing ESE science planning documents (ESE Strategic Plan, Earth Science Implementation Plan, Easton Report)
- ESTO has identified critical technologies of overall importance to ESE
  - Large deployable structures
  - Radiometers
  - Radar
  - Laser/LIDAR
  - On-board computing
- NMP has identified key component technologies that could potentially require a validation in space to reduce their cost and risk to the first science user
  - Large, Light-Weight Deployable Antennas
  - Light-Weight Deployable UV/Visible/IR Telescopes
  - Ultra-High Data Rate Communications
  - Intelligent Distributed Spacecraft Infrastructure
  - High Performance Spectrometry
- These candidate technologies were presented to the ESE Associate Administrator for his review and concurrence

Motivations

- Engage Code Y Science community more directly
  - To get buy-in to planning process
  - To 'own' products of planning
- Disseminate information much more widely
  - Larger NASA community
  - Non-NASA
    - OGA
    - Academia
    - Industry

Participation



Total Count :400+

Breakout Session Chairs and Facilitators

TOPIC	Co-chair	Co-chair	Facilitator
Lightweight Deployable Antennas	R. Kakar, NASA HQ	D. Schaubert, U Mass	M. Lou JPL
High Rate Comms	Glenn Prescott, NASA HQ	K.Bhasin, GRC	F. Lansing, JPL
Deployable Telescopes	E. Browell, LaRC	F. Peri, GSFC	R. Connerton, GSF(
Distributed S/C Infrastructure	M. Schoeberl, GSFC	J. Bristow, GSFC	C. Raymond, JPL
Precision Navigation	J. LaBrecque, NASA HQ	P. Axelrad, U Colo.	J. Hartley, GSFC
Onboard Data Processing	E. Paylor, NASA HQ	G. Bothwell	A. Walton, JPL
Integrated Optics and Spectral Dispersion Technologies	D. Wickland, NASA HQ	J. Gleason, GSFC	D. Crisp, JPL
Laser Technology	U. Singh, LaRC	J. Spinhirne, GSFC	R. Menzies, JPL
Innovative technologies	L. Schuster, NASA HQ	B. Wilson, JPL	M. Buehler, JPL

Breakout Session Objectives

- Clarify the relevance of each class of technologies for future ESE science mission objectives
  - new science investigations enabled by technologies
    - new measurement type, new vantage points (MEO, GEO, L1, L2)
    - requirements for spatial, temporal, or spectral resolution or sampling
    - needed by multiple themes?
  - anticipated time scale for science mission
- Identify technology subsystems that address these needs
  - current state of the art
  - capabilities enabled by new technology
  - current Technology Readiness Level (TRL)
  - ongoing technology development / investments (NASA, OGA, …)
- Identify requirements for flight validation
  - justification
  - objectives, scope, and milestones
  - top-level validation flight development schedule

Breakout Session Products

Science Capability Need

- Relevance to Future ESE Science Missions
- Science / Measurement Requirements
  - Application to Multiple Missions

Candidate Technology State of the Art

- Description/Illustration of Technology
- Major Technology Elements and TRL
- Technology Development Roadmap
  - Technology State of the Art
  - Ongoing Investments / Investment Strategy

Implementation

- Ground development / Validation (TRL 1 - 4)
- Flight Validation
  - Description/Justification/Benefits
  - Accommodation Requirements / Schedule

Sample Output-- On-board Processing

TECHNOLOGY DESCRIPTION			VALIDATION EXPERIMENT				Notes from workshop
Future Mission Type (ESE Mission applicability)	Challenge Description	Technology Approach	DRIVER(S) FOR FLIGHT VALIDATION	OBJECTIVE	SCOPE	MILESTONES	
VISION	Need radiation tolerance (~100Krad) within one generation of current technology with reliability of rad-hardened.	Software/hardware augmentation for SEE/SEU susceptibility	Cannot reproduce space environment on ground	Demonstrate system reliability, quantify improvements	Piggyback on long-term mission. Multiple processors.	1. Find "new" hardware (Year 1) 2. Develop fault tolerant operating system (Year 2) 3. Formal ground test (Year 3) 4. Perform space experiment (Year 4)	RADIATION TOLERANT PROCESSORS. Candidate for piggyback on operational mission in high-rad conditions. '08 candidate
		Radiation-tolerant libraries	none				RADIATION TOLERANT DEVICES. NASA support needed for ongoing library upgrades to keep up with industry developments.
Global Precipitation Mission, any multi-platform mission	Communications Node/ Rad tolerant network interface	Develop common network node to fly on multiple spacecraft	Can't reproduce on the ground because of distances and geometry	Demonstrate a working spaceborne network (packet switching core)	Piggyback multiiple spacecraft/missions	1. Develop network architecture 2. Develop HW architecture for switching 3. Develop comm arch 4. Develop Routing SW/protocols 5. Fly (2 years to build)	COMMUNICATION NODE/RAD-HARD NETWORKS. System development -- demonstrate system maturity
	Allows common data exchange architecture Distributed systems	Develop a packetized, high speed rad- hard data bus	Develop high-speed communication components	Demonstrate a standard component interface	Any host mission - (piggyback)	same as above	Saves cost, enables future adaptation, open system standard -- simplifies and facilitates future missions

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Sensor Webs, EOS-1 Hazard detection (earthquake, buoys)	(Planning) Autonomous spacecraft contro; SW for autonomous mission operations	Onbd planning scheduling, synchronization, hazard checking, resource mgmet, event handling	Long term system level complexity, faults, asynchronous processing, latency	Multisensor fusion/web; hooked to an incremental planner	Value-added multiple sensor mission (could be dedicated or piggyback)	1. Develop SW reqts (Year1) 2. Dev software (e.g., target processing algorithm) 3. Run planner on ground 4. Run piggyback mission 5. Run multi-SC mission ['05 timeline]	SW Autonomy session
	(Interesting targets) Feature Extraction	Target handoff, region classificaton, templated matching, model-based	Target handoff to other spacecraft and instruments. (Instrument specific). Ability to use identified features in planner in previous line).				
Hyperspectral instruments, large data intensive systems (SARs) [SW-inst]	Data reduction, more effective bandwidth utilization, fault tolerant and robust	Develop common packages for data compression and Fourier transforms, selection and segmentation	Validate fault models, reliability, accuracy. Scientific acceptance: demonstrate robustness	Demonstrate advanced fault-tolerate software. Dramatic reduction in downlink bandwidth or increased use of existing link. Quantify and enable new science - 10x or more.	Value-added to appropriate missions - hyperspectral, Firesat. Could be piggyback.	1. Science collaboration. Could fly soon - new hardware development not necessary.	Timely. Tightly coupled with instrument developers.